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ANNUAL WHITE SWEET CLOVER AND STRAINS OF THE BIENNIAL FORM

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UNITED STATES DEPARTMENT OF AGRICULTURE
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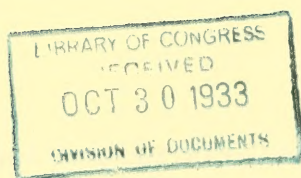
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ANNUAL WHITE SWEET CLOVER.

In the spring of 1916 Prof. H. D. Hughes, of the Iowa Agricultural Experiment Station, discovered that certain white sweet-clover plants growing in the greenhouse were blooming the first year. Later in the season Mr. H. S. Coe, of the United States Department of Agriculture, found similar plants at both Redfield, S. Dak., and Fargo, N. Dak., in the regional strain plats sown with Alabama seed. The other plats showed no annuals. Prof. Hughes distributed small quantities of seed to agricultural experiment station workers and to some private individuals, some of whom have propagated the seed and sold it at high prices. During the season of 1920 one firm contracted for 20 bushels of seed at \$300 a bushel.

Naturally, much interest was aroused by statements of the rapid growth of this variety. During the past two years many articles have appeared in the agricultural press commending the crop very highly. It has even been predicted that it would revolutionize the agriculture of the corn belt. The nature of this new variety is certainly such as to indicate that it may have important possibilities. Whether all of these hopes will be realized remains to be seen.

Though Prof. Hughes was the first to call the attention of agronomists to the variety, it had probably been observed by the late Prof. S. M. Tracy as early as 1898. In "Forage Plants and Forage Resources of the Gulf States," he says, writing of *Melilotus alba*, "a few plants will produce seed the first year and a few will live three years."

It is, however, uncertain whether Prof. Tracy referred to genuine annual plants or to the biennial form which sometimes blooms

the first year. In 1917, when Mr. Tracy's attention was called to the discovery of the annual, he insisted that the words quoted above referred to the annual variety. Some time before 1916 Dr. W. B. Gernert, then of the Illinois Agricultural Experiment Station, discovered the annual variety and propagated it to some extent. In a letter dated April 15, 1918, Prof. C. G. Hopkins said: "The Illinois station has been growing the annual white sweet clover for several years. In 1917 we harvested about 5 bushels of seed, and we now have about 10 acres of this crop growing." In 1914 the Illinois Agricultural Experiment Station had photographs and notes on this variety together with records of the comparative weights of the

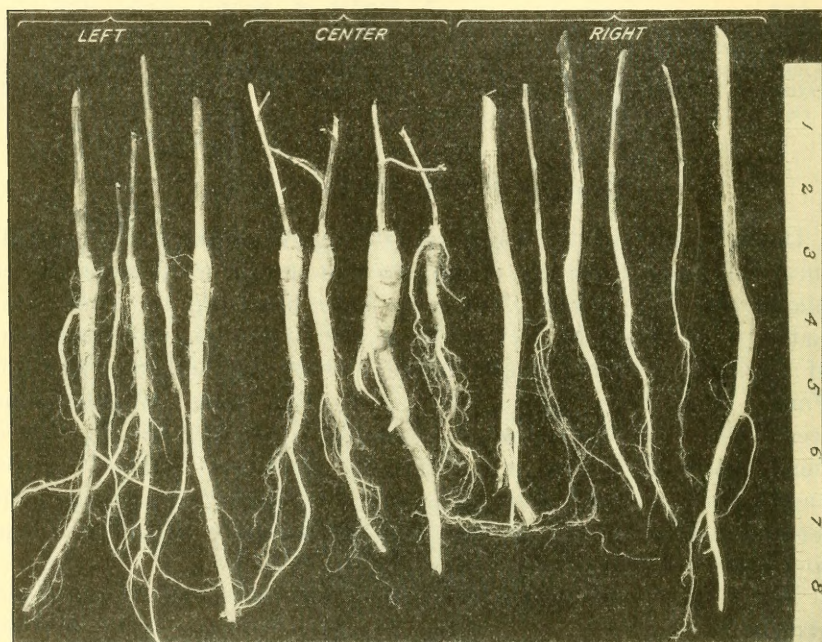


FIG. 1.—Roots of white sweet clover: Left, wild growth of the biennial form; center, biennial form from a cultivated row; right, annual form from a cultivated row.

annual and the biennial forms. Dr. Gernert has kindly supplied from these records the data shown in Table I.

TABLE I.—*Growth data of the annual and biennial forms of white sweet clover at the Illinois Agricultural Experiment Station.*

Specification.	Annual form.	Biennial form.
Height.....centimeters..	157	119
Air-dry weight:		
Top.....grams..	88.62	117.54
Root.....do.....	8.93	33.69

The annual variety was also observed in Arkansas in 1916. The writers are indebted to Dr. Gernert for a reference to Gleanings in Bee Culture, December 15, 1916, where this observation is recorded.

There is no record at the Iowa Agricultural Experiment Station showing where the original seed out of which the annual variety was selected was grown. The Illinois strain was selected from a lot of seed purchased in Falmouth, Ky., and reported to have been grown in Alabama. The plants found at Redfield and Fargo were in plats sown with seed from Alabama.

Mr. Coe described the annual variety, giving it the name of *Melilotus alba* var. *annua*, and called attention to the botanical characters in which it differed from the biennial plant.

The annual has a smaller, more woody root than the biennial form, and crown or resting buds are not formed. (Fig. 1.) The stems, branches, leaves, flowers, pods, and seeds are indistin-

guishable from those of the biennial form, but during the season of seeding the plant grows more rapidly, blossoms, fruits, and dies. (Fig. 2.)

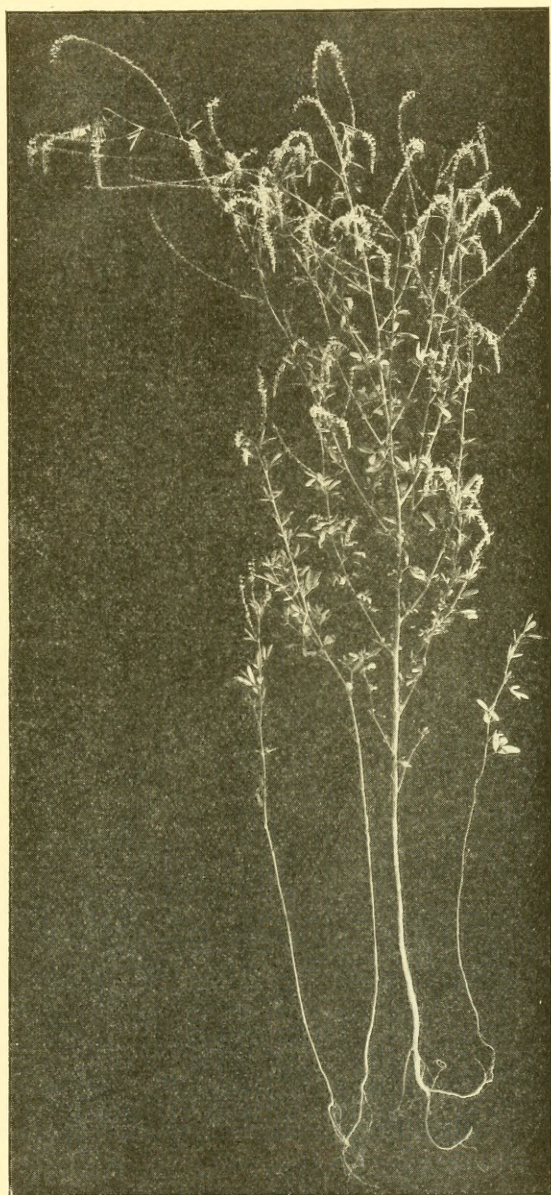


FIG. 2.—A group of annual white sweet-clover plants 4 months after seeding. The plants vary in size and development.

WILD ANNUAL WHITE SWEET CLOVER.

The seed of annual white sweet clover that has been sold so far and most of that on the market during 1920 was produced from the Iowa strain. During the summer of 1920, however, interest in this variety was aroused in Alabama, in Hale and Perry Counties, where it occurs with the biennial form, and some seed from that source will doubtless be on the market later.

It is not possible at present to place any limit on the range in which annual white sweet clover may be growing wild. It has been found chiefly in Alabama, but is also present in natural wild growths of *Melilotus alba* about Washington, D. C. In waste places near the Potomac River in Virginia, just outside of Washington, there are considerable areas used as dumping places for mortar and building refuse. These dumping grounds are covered every summer with a dense growth of sweet clover, and a few annual plants are to be found. Their number would equal but a small fraction of 1 per cent of the total plant population, however.

How, when, or where the annual variety originated is not known. Statements have appeared to the effect that the very hill slope in an Alabama county on which this variety originated had been located. It seems doubtful whether such claims can be taken seriously, with the evidence at hand. As already stated, it is probable that this variety was observed in the South as early as 1898. The fact that annual specimens were found about Washington after careful search over considerable areas of wild growth suggests that the tendency to sport in this way may be inherent in *Melilotus alba*. Conditions in Alabama may have been especially favorable for the increase of this variety, thus giving it greater prominence there.

So far a very superficial examination has shown that the plants occur in sufficient abundance for seed gathering only in the counties in Alabama mentioned. The harvesting of seed appears to be done mainly about Uniontown and Newbern. Throughout this section the annual plants are found either mixed with the biennial form or in more or less pure growths in fields or in patches. Since the two varieties occur in more or less mixed stands, the purity of the seed gathered depends on the ability of the person harvesting to distinguish the two forms.

In the latitude of Washington, D. C., the annual plants begin to bloom at about the time the biennials are in full bloom. Both forms have, however, a long flowering period, and during most of the time from the middle of July to September both annuals and biennials may be found bearing flowers and young or mature pods.

**CAN THE ANNUAL PLANTS BE DISTINGUISHED FROM THOSE OF
THE BIENNIAL FORM?**

The annual and the biennial forms, of course, can be readily distinguished by the roots, as already explained. When harvesting seed,

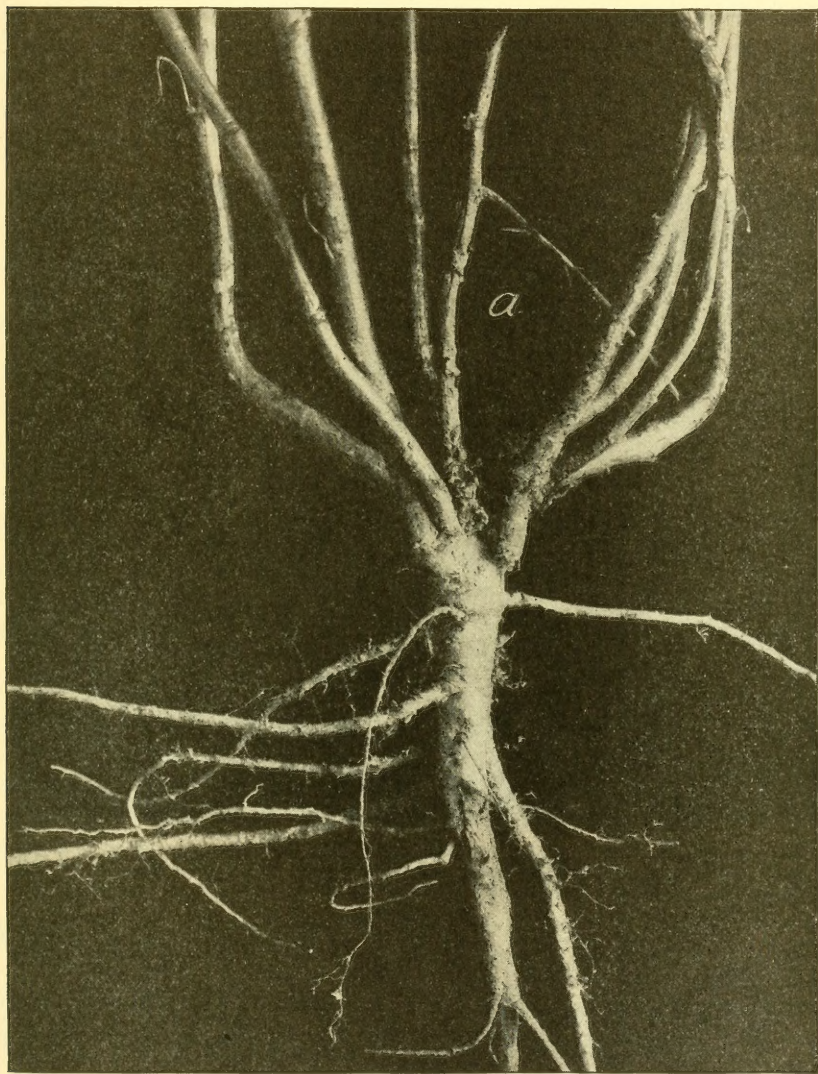


FIG. 3.—Typical biennial white sweet-clover plant during the second season. Note the dead stubble of the previous year's growth (*a*) and the many branches from the crown buds.

however, one can not examine all the roots. When the growth of the biennial form in bloom is typical, it has also a distinctive habit. The slender stem of the first season's growth is killed and is represented

by a stub or dead tissue. Around this stub and coming from the crown are two to several strong branches, the growths from the resting buds (fig. 3). Such branches never occur in the annual form.

The habit of growth of the biennial is not always typical, however. In every natural stand, especially if it is thick, there are a number of plants with apparently one central stem only. An examination of the root will show that this stem is not truly central, but has come from a lateral resting bud. By the suppression of the other buds and the total disappearance of a central stem, the one branch appears to be a central stem (fig. 4). How large a percentage of such plants may

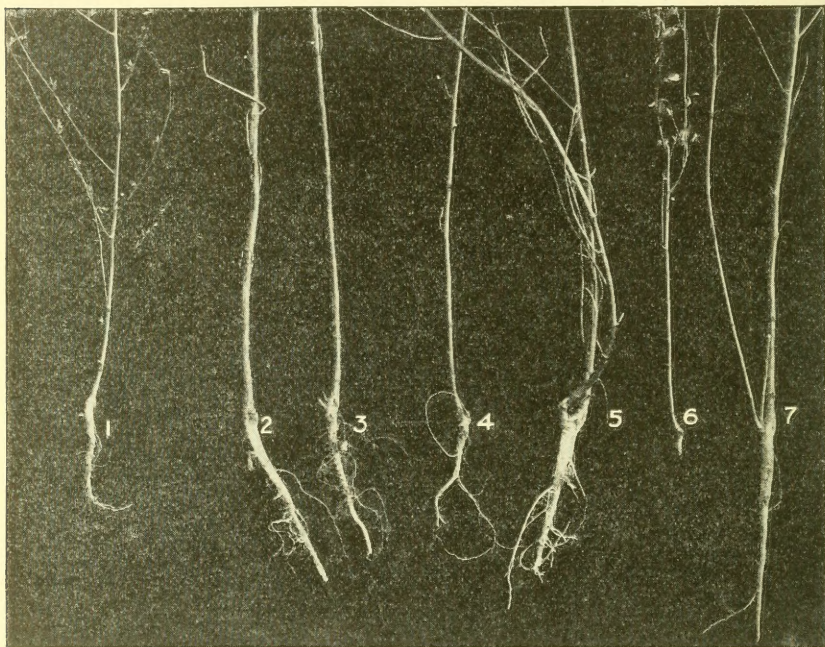


FIG. 4.—Stems and roots of biennial white sweet clover. The four stems at the left may readily be mistaken for those of annuals. Note the old stubbles on several plants.

occur in a natural stand of biennial sweet clover is not known, but it can readily be seen that where a mixed growth of annuals and biennials occurs such plants are easily mistaken for annuals. Great care will be necessary, therefore, when harvesting seed from such a stand.

CAN THE SEED OF THE ANNUAL BE DISTINGUISHED FROM THAT OF THE BIENNIAL FORM?

The statement has been made that the seed of the annual white sweet clover can be distinguished from that of the biennial form,

but the Seed Laboratory of the United States Department of Agriculture has been unable to confirm this statement.

The writers secured from a reliable correspondent in Wilcox County, Ala., a large number of samples taken from both annual and biennial plants of white sweet clover. Samples were also obtained by an agent of the United States Department of Agriculture from lots of seed harvested in Alabama as that of the annual variety. Further samples were taken from plants grown from the department strain of the annual form. All of these, together with authentic biennial seeds and commercial biennial seeds, were submitted to Mr. F. H. Hillman, of the Seed Laboratory, with the request that a study be made to determine whether any constant and reliable difference exists by which seed of the annual may be certainly distinguished from that of the biennial form. His report is given herewith.

The 62 samples of seed of sweet clover, part from annual and part from biennial plants, were received with your letter of August 31.

These samples are our Nos. 724077 to 724138, inclusive. I have examined them with a view to finding means by which seed from annual plants may be distinguished from that from biennial plants.

Both pods and seeds have been carefully examined under a low-power compound microscope, and I fail to find any external characteristics by which pods or seeds from annual plants may be distinguished from those from biennial plants.

Pods from different lots sometimes differ considerably in appearance, apparently due to conditions prior to harvesting, but this is evident alike in pods from both annual and biennial plants. Likewise, differences in the seed are observable, but they appear in seed from both types of plants.

Later, seed of the Iowa strain of the crop of 1920 was secured from the two largest producers. This seed could not be distinguished from that of the biennial form.

It appears, therefore, that no one can tell whether any particular lot of seed is that of the annual or the biennial form. This is of great importance, in view of the present interest in the variety and the high prices being paid for seed. To the possibility of honest error, especially in the case of wild seed, must be added the temptation that always exists in such cases for dishonest dealers to sell seed of one variety for that of the other or to mix the seed. Buyers are cautioned to use care and whenever possible to demand the pedigree of the seed offered. The strain developed by the United States Department of Agriculture has not been generally distributed, and samples of the Illinois strain are reported to have been sent only to several persons in Edgar County, Ill., in the spring of 1919 and again in 1920. All commercial lots offered during the season of 1920-21 as specially grown should therefore trace back to the Iowa strain.

VARIATIONS IN ANNUAL WHITE SWEET CLOVER.

The biennial white sweet clover is extremely variable, varying in size, habit, productiveness, and date of maturity. Many of the variations are certainly due to local conditions, such as the presence of an abundance of lime or the absence of lime. Many variations are, however, undoubtedly inheritable.

The annual white sweet clover is also extremely variable. During the summer of 1920 the United States Department of Agriculture

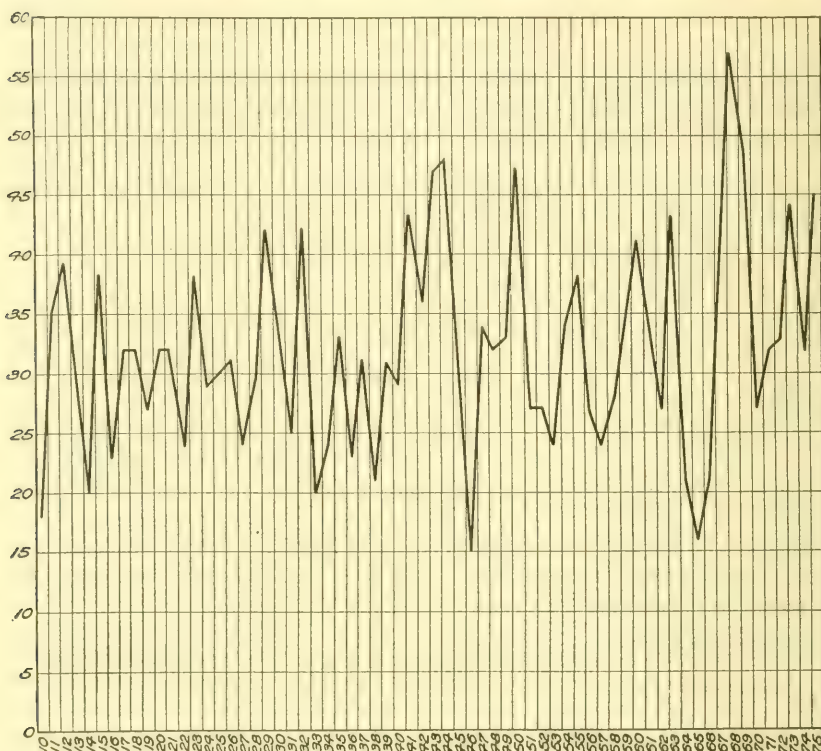


FIG. 5.—Relative heights in inches on July 16 of 65 annual white sweet-clover plants grown consecutively in row 10001-C by the United States Department of Agriculture.

sowed several rod rows to various lots of annual white sweet clover, the seed being selected from the department strain, from the Iowa strain, and from the Illinois strain. So far as is known, none of these selections were from self-fertilized individual plants. The plants of each row were thinned to stand from 6 to 8 inches apart in the row. All the plants of a lot thus had practically identical soil conditions. The diagram (fig. 5) represents the variations in height of 65 consecutive plants in the row of the department's selection No. 10001-C. Seed was sown on April 10, 1920, and measurements were made on July 16, at which time most of the plants were coming

into bloom. The plants in the other rows showed similar variations. In date of blossoming there was also considerable variation. The first observation was made on July 14, when fully opened racemes were found on many plants. These were all removed. Later observations showed that different plants came into flower at various times and as late as August 10.

The diagrams (fig. 6) show the relative percentage of all the plants in a lot that came into flower at the dates specified.

Much variation was also noted in branching habit, leafiness, and seed-producing capacity.¹

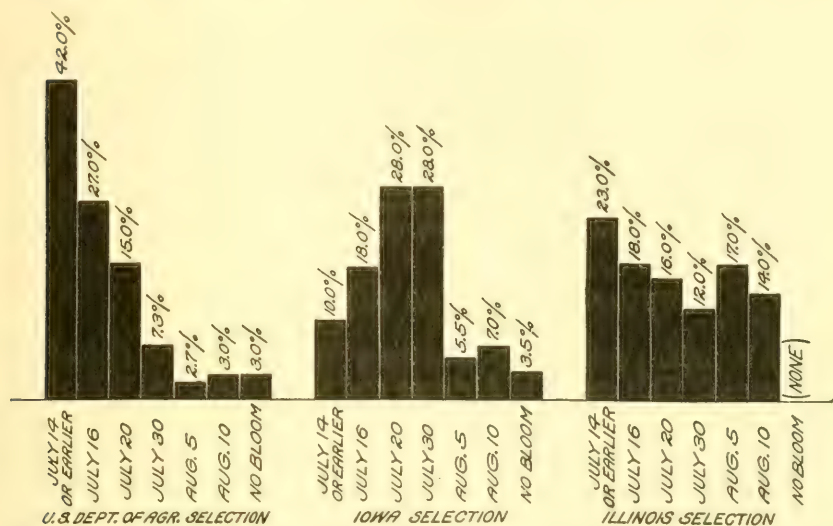


FIG. 6.—Diagrams showing the percentage of plants of annual white sweet clover which blossomed at different dates.

None of the annual white sweet-clover strains so far tested by the United States Department of Agriculture are wholly free from some biennial blood. During the past summer, samples of five lots were planted at the Arlington Experimental Farm, near Washington, D. C., and also in cooperation with the Tennessee and Kansas Agricultural Experiment Stations at Knoxville, Tenn., and Manhattan,

¹ While this circular was in press, information was received from Mr. Willis Crites, a breeder of annual white sweet clover, that plants grown in the greenhouse from wild Alabama seed of the annual form are much earlier than those from the Iowa strain. On February 4, plants from the Alabama strain were 30 inches high, while those from the Iowa strain were 9.9 inches high. Alabama seed planted for increase in Texas is also said to have produced plants materially earlier in maturity than those from the Iowa strain. As has already been pointed out, the annual forms of white sweet clover are extremely variable in date of maturity, and Mr. Crites suggests that since in Alabama the earlier strains ripen before the seed crop of the biennial forms is harvested seed of the later strains only will occur as mixtures in the biennial seed. The Illinois annual strain and also that of the United States Department of Agriculture are known to have been selected from seed of the commercial biennial form grown in Alabama, and this was probably also the case with the Iowa strain.

Kans. The percentage of biennial plants resulting in each case is shown in Table II.

TABLE II.—*Percentage of biennial plants grown in 1920 in Virginia, Tennessee, and Kansas from seed of annual white sweet clover.*

United States Department of Agriculture numbers.	Arlington, Va.	Knoxville, Tenn.	Manhattan, Kans.
10001-A.....	4.3	3.95	3
10001-B.....	5.9	4.70	3
10001-C.....	3.0	2.04	1
10030 (Iowa).....	3.5	8.00	2
10042 (Illinois).....	0	1.17	4
Tennessee Early.....		0	

Seed lots numbered 10001-A, 10001-B, and 10001-C were various selections made by the United States Department of Agriculture and were, respectively, the second, third, and fourth generations from the original plants found in the Alabama plat at Redfield, S. Dak. The Tennessee Early was a selection made by the Tennessee Agricultural Experiment Station from seed received from Prof. H. D. Hughes.

ANNUAL BLOSSOMING BIENNIAL FORMS.

The biennial sweet clover sometimes blossoms in the fall of its first season. This occurs in Alabama and Mississippi, and it has been found more or less frequently in both wild and cultivated stands about Washington, D. C.

On the dumping grounds near Washington previously referred to, some 30 biennial plants were found in bloom on an area of perhaps 5 acres. These plants had normal resting buds and large roots. On a few ripe seeds were found, but for the most part the flowers opened too late to set seed before frost (fig. 7). In a field some distance from Washington, near Gaithersburg, Md., that had been sown to white sweet clover in the spring of 1920 a large number of such flowering plants were found. Possibly this habit may not be uncommon in the biennial form, but so far as known there are no recorded observations on this point.

USES FOR ANNUAL WHITE SWEET CLOVER.

It should be understood that whatever is said about the probable uses and value of annual white sweet clover is based mainly on the characteristics of the plant and general knowledge of agriculture rather than upon results obtained in field experiments with the new crop.

Annual white sweet clover makes a rapid growth after becoming established, blooms early, and ripens seed about August when seeded

early, and dies after seeding. The root system is slender and the roots relatively woody, compared with the roots of the biennial form.

Many farmers, agricultural writers, and some experiment-station workers are very enthusiastic about the possibilities of this variety. One eastern agricultural paper said "we believe the discovery of this plant is to work a revolution in the cultivation of our northern soil."

So far as the United States Department of Agriculture is aware, no comparative trials have been made with annual white sweet clover. This is quite natural, as there has not been seed enough for extensive trials. The supply available in the fall of 1920 is probably not more than 150 or 200 bushels, all held at figures too high to warrant its use in growing a hay or a green-manure crop. Some reports regarding this variety have appeared, however, in the agricultural press, and the writers have received some data by correspondence. These reports so far as they appear to be based on actual observations are considered in what is said below.

Probably the greatest use of annual white sweet clover for hay will be as an emergency crop. When a stand of clover has been winter-killed or when for any reason a farmer finds that his hay supply for the season will be short, this variety can be seeded on any vacant piece of land, provided lime and the proper bacteria are present, with every expectation of a fair to good hay crop. Prof. J. F. Cox, of the Michigan Agricultural College, wrote that in early July the

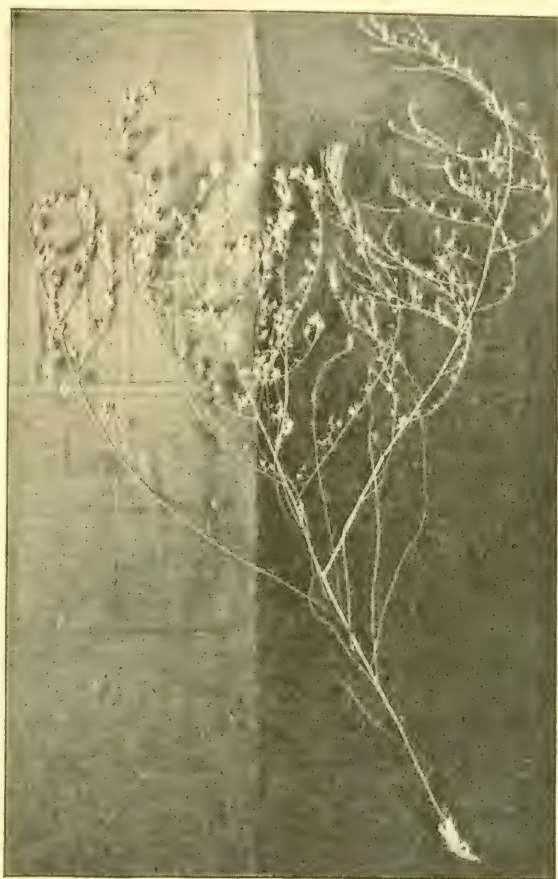


FIG. 7.—A biennial white sweet-clover plant which blossomed in the autumn of its first season. Note the large crown buds below and the two flowering branches.

stand "would undoubtedly have given a yield of hay comparable to a heavy cutting of alfalfa or clover;" also that at the "Upper Peninsula substation at Chatham an excellent forage growth was secured."

Where rainfall is sufficient annual white sweet clover may be seeded even after wheat harvest.

It is possible that this annual variety may help in controlling the Hessian fly. Entomologists have shown that for the control of this pest the wheat stubble should be plowed immediately after harvest. The presence of red clover in the stubble usually makes this undesirable, however. With the annual white sweet clover it may be possible to plow the wheat stubble and still make a hay crop the same season. This can also be done with soy beans, but at considerably more expense than is required to grow a crop of sweet clover. The rapid growth of annual white sweet clover will probably enable it to keep ahead of the weeds.

Those most enthusiastic about this variety expect great things from it as a soil builder and source of nitrogen. An Illinois man, one of the leading county agents in the United States, whose opinion must be regarded with respect, writes as follows:

I consider the place that this clover will play in our agriculture, perhaps, first of all the clovers . . . Instead of 4-year rotations in the corn belt, consisting of corn, corn, oats, and clover, we would have a 2-year rotation of corn and small grain seeded to sweet clover; in other words, on 160 acres of land 80 acres would be in corn and 80 acres in small grain seeded to sweet clover. This 80 acres seeded to sweet clover would be fall plowed for next year's corn crop. You eliminate the danger of winterkilling of red clover, and there would be turned under a legume on 80 acres per year instead of 40 acres per year. This, I believe, will solve the corn-belt nitrogen problem, especially on grain farms.

In considering the possible value of a green-manure crop where there is as yet no actual performance, the characteristics of the crop and general principles must guide in forming conclusions. A good green-manure plant should be an efficient nitrogen gatherer and produce a large mass of material for turning under. It must fit into farm practice, unless, indeed, the crop becomes so important that farm practice, especially in rotations, is altered so as to permit its use. The best time to turn under a green-manure crop so as to get the maximum benefit, the desirability of spring or fall plowing, and the need or value of a winter cover crop must also be taken into account. No analyses have yet been published covering the quantities of organic matter and nitrogen in a crop of annual white sweet clover. This clover is known to make a good growth the first season, and experience in Iowa and Michigan has shown that it may be seeded on winter wheat or with oats and will make a fair to good growth after

the grain is harvested. Agricultural practice varies under different conditions of soil and climate, so that what may be good practice in one section may be bad in another. Further data in regard to the relation of annual white sweet clover to these various factors will doubtless develop in the next few years. It is particularly desirable that studies be made of the effect on nitrate production and conservation of turning under a dry, ripe crop of annual white sweet clover in the fall. Whiting and Schoonover, at the University of Illinois Agricultural Experiment Station, have shown that there was considerable nitrate formation in the fall, continuing to the end of November or later; also that nitrates might be lost in early spring when there was no crop on the ground. These facts may have a bearing on the total nitrates that may be made available for a corn crop by turning under a crop of annual white sweet clover the preceding fall.

In north-central Indiana hogs are pastured on clover in the spring, before the field is plowed for corn. With annual white sweet clover this practice will be impossible. It must be borne in mind that the annual form can not be used for a hay crop or a seed crop and for a soil improver at the same time. When a hay crop is cut the growth is mostly at an end. It has been abundantly demonstrated that legumes take only a part of their nitrogen from the air. The best of them leave little, if any, increase of nitrogen in the soil when only roots and stubble are turned under. With the relatively slender root system of annual white sweet clover it may be doubted whether the soil will be improved unless the entire crop is turned under.

In certain grain-growing sections red clover is seeded in wheat, to be turned under for the next wheat crop. Annual white sweet clover may prove to be well fitted for such rotations. It will almost certainly make more growth during the season than either red clover or the biennial sweet clover and will have the additional advantage over the latter that it will be dead when turned under in the fall and will not volunteer in the grain the next season.

As an orchard cover crop the annual white sweet clover may have an important place. In Nebraska a cover crop that will die in the fall is wanted. This clover would be such a crop. In many orchards on the Atlantic coast also a legume that will die in the fall, leaving a good growth of dead stalks to hold the snow, may be useful. A correspondent in Ohio believes that a mixture of annual white sweet clover and hairy vetch seeded in orchards and vineyards in July may prove valuable.

Perhaps the most important place for annual white sweet clover as a soil improver will be as a catch crop, to be seeded after early potatoes, grain, or any crop coming off by early August. Seeded at that time this will make a considerable growth before frost. At

the Arlington Experimental Farm, Va., the annual white sweet clover was seeded on August 11. On September 20 the plants were 2 to 6 inches high, and on October 16 they averaged knee-high. It



FIG. 8.—Plants of annual white sweet clover on October 16, 65 days after seeding. At the left, three plants from seed sown in an open field; at the right, six plants from a seeding in an adjacent cornfield.

should be noted, however, that a planting in corn made on the same date failed to make a satisfactory growth (fig. 8).

Studies in green manuring have established the fact that for the greatest benefit, such a manure should be turned under so that the

maximum decay will take place during the height of the growing season. This will probably never be possible with annual white sweet clover. Illinois farmers have found, however, that considerable soil improvement, as measured by crop returns, takes place when the crop residues from a sweet-clover seed crop are turned under in the fall. The annual variety may act similarly, but there will not be as large a quantity of dry matter in a single season's growth of the annual as in a seed stand of the biennial form.

The opinion of many men of good judgment is that the new variety will prove valuable. It has its limitations, however, and these should be frankly recognized. Unless this is done, there is certain to be considerable disappointment, and a reaction may set in against it. For a crop to be valuable for green manure, especially as a catch crop, it is essential that the seed be cheap and always readily obtainable. The annual white sweet clover can not be expected to make both a hay and a seed crop, as red clover and biennial sweet clover do. The seed will have to be grown as a special crop. While the high prices at present prevailing continue, plenty of seed will be produced, but eventually the industry, if it is to live, will have to be based on the value of this variety as a forage or soil-improving crop. Unless a regular demand for the seed develops at prices at which farmers can afford to use it liberally for the purposes specified, the variety will fail to make a place for itself.

It has seemed well, therefore, to offer the suggestions contained in this circular with the hope that as soon as more seed is available many trials of this variety will be made. In this way its proper place in our agriculture will soon be determined.

VALUE OF DIFFERENT VARIETIES OF BIENNIAL WHITE SWEET CLOVER.

During the past 10 years there has been a rapid advance in interest in sweet clover, especially white sweet clover. The crop has been introduced into many sections in which it was not before cultivated, so that to-day it is highly regarded from Alabama to North Dakota and from New York to Montana. The seed is now produced in many States. In the process of seed production a number of distinct strains or types have appeared, some of them markedly different in size, vigor, and time of maturity from the common wild sweet clover. Sufficient time has not elapsed to fix the characters of all the various strains, but a few special strains have appeared, and it seems probable that as this crop is kept under more careful observation, other more or less distinct strains will be found. Whether these strains will be of value can be determined only by repeated trials. We know, in general, that strains of cultivated plants that may prove

valuable for one purpose may be useless for another and that some may be better able than others to withstand drought, alkali, and other unfavorable conditions. We may expect, therefore, that this will be the case with sweet clover. The attention of growers of sweet clover especially is directed to this matter, in order that further observations may be made and recorded.

Attention should be called at the outset to the fact that the value of a variety depends on the use to which the crop is to be put. Sweet clover is used for forage, pasture, and soil-improving purposes. The seed is used only for sowing. True, at this time seed growing is of great importance, because the rapidly increasing use of sweet clover makes heavy demands on the seed crop. A strain, however, that produces a large quantity of seed and but little forage or pasture or which has no special value as a green-manure crop would have to be classed as an inferior variety. On the other hand, a strain might appear that, while of superior forage or pasture value, was so poor a seed producer as to make it unprofitable. The ability to produce seed plentifully is of distinct value, provided the resulting crop is as good as or better than that produced by the seed of other strains.

STRAINS OF BIENNIAL WHITE SWEET CLOVER.

At the Agricultural Experiment Station of the University of Illinois a study of individual strains of sweet clover was commenced in 1913, but no results have yet been published. In 1916 seed harvested in the States of Alabama, Mississippi, Kentucky, Kansas, North Dakota, Montana, and Wyoming was sown at the field station of the United States Department of Agriculture at Redfield, S. Dak., and at Fargo, N. Dak., the latter in cooperation with the North Dakota Agricultural Experiment Station. Further sowings were made each year up to 1919, when the final sowings in this series were made at Fargo. Besides the lots mentioned, seed from Oklahoma and South Dakota and two lots from Illinois were included in the test in 1917. Little is known of the history of these regional strains.

The seed from Alabama, Mississippi, and Kentucky probably had a long local history, while that from the northern stations can certainly not have been grown there for many years. No final conclusions can yet be drawn from these tests; so far, the results are suggestive only. Each year notes were made on the extent of winterkilling, and the weights of hay were taken. The results with seed of Alabama and Mississippi origin have quite consistently been less satisfactory than those with northern and western grown seed. On the other hand, Oklahoma seed has given results equal to the best, and results with Wyoming seed have been unsatisfactory. It is doubtful whether the term "regional strains" has any but a vague general significance at

present. With the exception of the seed from Illinois, these regional strains did not differ from one another in size, earliness, or other characters, except possibly in winter hardiness, although the evidence is inconclusive.

Only two distinct varieties were found, both from Illinois and both earlier than the common white sweet clover. One of these, No. 1619, has a partly decumbent habit and appears to be somewhat inferior, both as a hay and as a seed producer.

GRUNDY COUNTY SWEET CLOVER.

The attention of the United States Department of Agriculture has lately been called to a special strain from Illinois, developed in Grundy County. Nothing is known of its origin except that the seed was first procured about four years ago from a local dealer. Like the other sweet clovers from Illinois, the Grundy County strain is earlier and not as tall as the ordinary biennial sweet clover. It has an erect habit of growth, most of the plants consisting of a single upright stem which does not branch freely until about 10 or 12 inches from the ground. The plants seldom grow more than 4 feet high, and the main stems are scarcely larger than a lead pencil. In leafiness the plants compare favorably with ordinary sweet clover.

The principal use of a sweet clover of the Grundy County type is for the production of seed. The plants being small are easily harvested with a grain binder, and the seed is readily thrashed with a clover huller. Furthermore, the plants ripen from ten days to two weeks earlier than ordinary sweet clover, which is a very practical advantage, since it brings the seed harvest before the winter-wheat harvest instead of right in the midst of it, and the sweet clover also ripens ahead of the weeds. The seed yield from the Grundy County strain has been about 10 bushels per acre, which is practically the same as that obtained from ordinary sweet clover. The ordinary plants are twice as large as the Grundy County plants and have more blossoms, but the seed yield is no greater, because the ordinary clover ripens unevenly and shatters badly, whereas the crop of the Grundy County type ripens all at once and all the seed can be saved.

There is little information as to the usefulness of the Grundy County type for hay and pasturage, as the demand for seed has been so great that practically all of the crop has been saved for that purpose. It is evident, however, that a sweet clover of this class is a specialized rather than a dual-purpose type and approaches the type previously referred to as excellent for seed production but of less value for forage. One of the main uses for sweet clover is as summer pasturage, to take the place of bluegrass and other pasturage which dries up by the middle of July. A sweet clover

which ripens by July 15 would therefore not be as desirable as one which stays green until August. In addition, the quantity of pasturage would probably be less, owing to the smaller size of the plants.

While as a hay producer this type can hardly equal the larger ordinary sweet clover in quantity, Grundy County farmers who have made hay from this strain are very enthusiastic about it both for its superior quality and the fact that it is more easily made into good hay than the coarser ordinary sweet clover. The finer stems, even the straw, make a good feed which is relished by live stock.

The exact opposite of the Grundy County type of sweet clover was found in northwestern Ohio during the summer of 1920. In at least three different localities a sweet clover was found which grew 10 or 12 feet high and was 7 to 10 days later in blossoming than ordinary sweet clover. The soil was rich virgin bottom land, but this does not account entirely for the unusual size or the delayed maturity of these plants. These mammoth plants produced a large quantity of seed, but were so unwieldy that the harvesting of the seed was not profitable. Because of their coarse, woody nature the plants were not suitable for hay, but they provided good late pasturage and were probably of superior value for enriching the soil.

A type of sweet clover resembling the Grundy County type has also been noted in western Ohio. These plants are uniformly smaller and earlier than ordinary sweet clover and are rather notable for their leafiness. Neither of the Ohio types has yet been developed commercially.

ARCTIC SWEET CLOVER.

A variety introduced under the name of Arctic sweet clover by the University of Saskatchewan appears to have been very successful in the Provinces of western Canada. It is said by Prof. Manley Champlin to have been developed by Profs. Bracken and Kirk from a sample received by them from Prof. N. E. Hansen, of South Dakota. It is presumably of Siberian origin and is said to be hardy, early, and a good seed producer. It does not produce as much forage as the common sort, but its hardiness, earliness, and good seed production appear to make it desirable for the extreme north.

Sweet clover should be a particularly easy plant with which to carry on selection work for the development of new varieties and types. The strains which have been selected already were acquired largely by accident, very little effort having been spent in a systematic search for types. Because of the widespread interest in this crop and the many uses to which it is adapted it would seem well worth while for farmers and official plant breeders to devote some time to the development of new and useful strains.

SUMMARY.

The annual form of white sweet clover has been known to be in existence for an indefinite time. Its possibilities as a crop plant were, however, first called to the attention of agronomists generally in 1916 by Prof. H. D. Hughes, of the Iowa Agricultural Experiment Station.

This variety differs from the biennial form in its more rapid growth and maturity. Crown buds are not developed, but the plant dies after producing seed.

When two or more crown buds develop on a biennial the habit of the plant when in seed is distinct from that of a seed-bearing annual, but when only one crown bud develops the biennial and the annual seed-bearing plants can not be distinguished with certainty.

The seeds of the annual are like those of the biennial form; they can not be distinguished. Seed is still scarce, some having been grown from the Iowa strain and some harvested from wild plants in Alabama.

Both the biennial and the annual white sweet clovers are quite variable as to height, leafiness, and date of maturity. The biennial form occasionally blossoms in the autumn of the first season.

There is at present no definite knowledge as to the value of annual white sweet clover, but agriculturists of experience consider that it will prove especially useful as a soil improver.

There are some well-defined strains of biennial white sweet clover. It is possible that others may be developed and found available for certain situations or uses.

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